JOHNS HOPKINS
CAREY BUSINESS SCHOOL

Designing Experiments [DRAFT for 2019]
2 Credits

BU.450.630.81

Tuesdays, 6pm-9pm
TBD - TBD

Spring 2019
Downtown Baltimore (Harbor East) Room TBD

Instructor
Paul Ferraro, Bloomberg Distinguished Professor, Bloomberg School of Public Health, Carey Business School & Whiting School of Engineering

Contact Information
Office: Carey 1308
I check email far more frequently than the voice mail - pferraro@jhu.edu, but here's my #: 410-516-6589

Office Hours
4:30 – 5:30 pm Tuesdays or by appointment. Visiting students are to check in at the 2nd floor reception, who will call me before sending you up. If I do not answer, have them call reception on the 13th floor – if you don't see me in office, a note on door will indicate where the office hours are being held. When more students show up than can fit in my office, we move to a larger room, like 1301.

Required Texts & Learning Materials
Gerber and Green's *Field Experiments: design, analysis and interpretation*. 2012.
- Note: The datasets used in this book, and error corrections, can be found at this Yale website.

The course reading list will also include journal articles. Most of these are available via the JHU Library electronic journals portal (www.**library**.**jhu**.edu/). Articles that are not available via the JHU Library will be posted on Blackboard.

Recommended Textbooks if You Plan to Run Your Own Experiments
Both have good practical information, whether you're going to run the experiment with a public or private program.

Orr, L. 1999. Social experiments: evaluating public programs with experimental methods.
Glennerster, R., K. Takavarasha. 2013. Running randomized evaluations: a practical guide.

Online Resources
Please log in to Blackboard for all materials related to this course that are not in the textbook.

Course Description
Students learn how to use experimental designs to measure the impacts of innovations in business, nonprofit and government programs. Students will learn how to implement randomized controlled trials and other experimental designs, which aim to measure the causal impacts of new products and programs, or changes to existing products and programs. The course relies on readings, guest speakers from private and public sectors, and homework that builds to a group project that designs an experiment.

Prerequisite(s)
BU.510.601 Statistical Analysis or BU.914.610 Quantitative Methods. Familiarity with using Excel and with the basics of linear regression is helpful.

Contact the professor if you are unsure whether your background is sufficient for the course.

Course Overview

Did a new compensation scheme motivate employees to work harder or stay with the organization longer? Do larger subsidies for health insurance lead to improved employee health and productivity? Did a new website format increase user activity on the site? Did a charitable organization's program to train community leaders lead to positive changes in the community? Cause and effect questions like these are crucial to developing evidence-based practice in business, nonprofits and governments. Yet answering these questions is difficult when new ideas are not implemented with the explicit intent of measuring their impacts. In other words, developing evidence requires a scientific approach to business and policy.

This class aims to teach students to develop empirical evidence about the best ways to achieve their aims, whether these aims are to increase profits or to address social problems. The use of randomized controlled trials to test program impacts is becoming increasingly popular in businesses and government. At any given time, Uber is running ~1,000 randomized trials. An Facebook employee estimated that the average FB user is participating in ~10 randomized controlled trials at any point in time. The U.S. government recently created a "Nudge Squad" that works with federal agencies to test new ideas through randomized controlled field trials. Experiments are an integral part of the 'big data' revolution going on in business, nonprofits and government. Importantly, they do not require advanced statistics or powerful computers to implement and interpret.

The course blends lectures, group discussions, readings, homework, a group project, and guest speakers from private industry, nonprofits and government agencies. I am a firm believer that the most fundamental principles can be stated in plain English. Thus the course stresses intuition (in English) over math and mechanics. Nevertheless, there will be math and mechanics in the course.

Whether you are a student with substantial experience with empirical methods or a student with only the pre-requisite covered, you should expect to gain a deeper understanding of an important approach to answering causal questions and of the nature of evidence itself. Importantly, you will learn an approach to creating evidence that you can apply in your job after leaving Carey. Although most of us think our ideas are great, most of our ideas are not. Did you know that of 13,000 experiments run by Google and Microsoft to evaluate new products or strategies, almost 90 percent found no impacts? Being able to quickly and credibly identify the 10% that are successful innovations is a critical business skill.

I have outlined a provisional syllabus below, but we can adapt it based on student interests and background. The main emphasis of the course is like any other graduate course: to encourage students to think critically, to speak and write simply and clearly, to own and use a body of facts and ideas that are widely known, to detect errors and fallacies, to resolve intellectual problems, and to advance our collective knowledge through independent research.

Course Topics

1. Does X cause Y? Causal states, potential outcomes, identification and treatment effects
2. Why experiment? What constitutes "good evidence?" Why bother with experiments when we have "Big Data?"
3. Experimental designs
    a. Randomized treatment assignment
    b. Randomized encouragement (also known as randomized treatment assignment with noncompliance)
    c. Experimental discontinuity designs
4. Statistical power analyses (and multiple comparison problem)
5. Threats to validity: interference, attrition and randomization biases
6. Designing experiments to estimate heterogeneous treatment effects (in other words, elucidating the factors that moderate the impacts of the treatment)
7. Ethics of human subject experiments by businesses, NGOs and governments.

Class lectures are meant to complement the readings and typed notes. If you are not required to read the entire reading, I will announce it in class. Otherwise, assume you are required to read it. If you are absent, lecture notes can be obtained from your classmates. I do not provide notes on lectures to students (except those that I provide via Blackboard).

Guest Speakers (examples from previous years)

1. Employee from White House's Social and Behavioral Sciences Team (a.k.a., the "Nudge Unit")
2. Staff running experiments at private companies (Facebook, Google, OPower, Pandora).
3. Staff from a large nonprofit (ideas42) that runs experiments with for-profit companies, governments, philanthropic organizations and other nongovernment organizations.

Learning Objectives

By the end of this course, students will be able to:

1. Explain what is meant by the term "causal effect" and why experimental designs facilitate causal inference.
2. Write hypotheses that can be tested using experimental designs.
3. When faced with a specific business or social problem, identify key attributes of the problem that can be elucidated through an experiment.
4. For a given causal question, describe an experimental design capable of uncovering a causal relationship, and discuss the advantages and disadvantages of such a design from the perspective of causal inference, implementation and applications.
5. Anticipate problems in the implementation of an experiment and identify ways to avoid such problems or interpret the results in light of these problems.
6. Evaluate the quality of evidence from both experimental and non-experimental designs.
7. Consider basic ethical standards for an experiment.

To view the complete list of Carey Business School's general learning goals and objectives, visit the Carey website.

Attendance

Attendance and class participation are part of each student's course grade. Students are expected to attend all scheduled class sessions and to participate in group exercises. Failure to attend class will result in an inability to achieve the objectives of the course. Excessive absence will result in loss of points for class participation. Regular attendance and active participation are required for students to successfully complete the course.

Electronics in Class

With regard to laptops & cell phones during lectures, I recommend you use neither except when a class exercise requires it. There are good experimental studies showing that (1) although you can type more than you can write in a given time period, writing leads to stronger conceptual understanding and ability to apply and integrate the material; and (2) texting in class (or multi-tasking more generally) leads to you to take notes of lower quantity and quality and to recall less of the lecture. But if you insist on using your laptop or phone during lecture, you must sit in the last two rows of class so that neighboring students are not distracted (so get to class early). You will turn the internet off on the laptop so as to minimize distractions and maximize class participation. All cell phones must be in vibrate mode.

Assignments

I will grade you based on your performance on homework problems, class participation (including keeping up with the readings), and a group project in which you will design your own randomized controlled trial. The homework problems will help you build up the necessary pieces for the experimental design.

Reading and homework assignments are posted on the Blackboard site for this course.

Assignment	**Learning Objectives**	**Weight**
Class Participation	1-7	15%
Homework Problems	1-7	35%
Final Project Paper	1-7	50%

Class Participation (15% of grade)

Class participation essentially means (1) that you show for most classes on time (you can miss one with no penalty) and (2) you show up having read the assigned readings. I will speak more about what I mean by class participation on the first day of class. As a token signal that you did reading, you must type up three substantive questions or comments on each assigned chapter or reading (but not the articles used for homework problems), and hand those questions/comments in at the beginning of class. Each set of questions for a chapter or reading should be on a separate sheet of paper. Please make it clear to which chapter or

article the questions/comments refer. These submissions will count towards class participation (you can miss one week with no penalty). The readings start heavy in the beginning of the semester and get lighter as we progress.

Homework Problems (35% of grade)
The problem sets are designed to bridge the gap between the lectures and readings and the application of the ideas in the lectures and readings. By doing the homework sets, students will also build up the pieces for their group projects. Students are strongly encouraged to work together to solve the problems, but each student must hand in his or her own work. These weekly assignments are also your opportunity to get feedback on your experimental design prior to submitting the final paper.

Final Project Paper (50% of grade)
One of the best ways to learn a subject is to obtain hands-on experience. The final project is designed to encourage you and your group (<=5 people) to design a field experiment on a topic of your choice. More details are presented at the end of this syllabus and we will discuss the requirements in more detail in class. I recommend you choose something manageable that demonstrates you understand how to put together the requisite components of a field experiment and can envision the analyses that you will do of the data. A well-posed and answered "small" question is much more desirable than an ambitious, but ultimately opaque tome. More complex designs yield opportunities for higher grades, but also more opportunities for getting things wrong. The approximate weights are:

- (70%) Explanation of the causal relationship of interest, description of the "ideal experiment," and description of your experimental design; complete explanation of units, outcomes, randomization procedure, power analysis, hypothesis testing strategy, how you will anticipate or address non-compliance, interference, attrition, or violations of excludability.
- (15%) ~20 minute presentation of your design to the class + Q&A
- (15%) Peer evaluation, which is limited to the final project paper work (there is no requirement that peers help each other with the regular homework, although such interactions are encouraged)

The topic must be selected in consultation with me. Start thinking about it **early**. The first homework is due on the third class and must contain the essential attributes of your project idea (what you are testing). You can see me in office hours if you are unsure whether your topic is appropriate.

Grading
Effective Fall 2017: The grade of A is reserved for those who demonstrate extraordinarily excellent performance as determined by the instructor. The grade of A- is awarded only for excellent performance. The grades of B+, B, and B- are awarded for good performance. The grades of C+, C, and C- are awarded for adequate but substandard performance. The grades of D+, D, and D- are not awarded at the graduate level (undergraduate only). The grade of F indicates the student's failure to satisfactorily complete the course work.

Please note that for **Core** and **Foundation** courses, a maximum of 25% of students may be awarded an A or A-; the grade point average of the class should not exceed 3.3. For **Elective** courses, a maximum of 35% of students may be awarded an A or A-; the grade point average of the class should not exceed 3.4. (For classes with 15 students or fewer, the class GPA cap is waived.)

Tentative Course Calendar
The instructors reserve the right to alter course content or adjust the pace to accommodate class progress. Students are responsible for keeping up with all adjustments to the course calendar. Changes will be also communicated through Announcements on Blackboard.

The pace of readings may be adjusted after communication with the students. If you want to get ahead, know that I expect that we'll be reading the following chapters in Gerber and Green textbook: 1-9 and Appendix A (chapters 7-9 will not be read in their entirety). I will encourage you (but not require you) to read Chapter 12, and Chapter 13 will help you write your group project. You will read at least two applied articles in full (two real experimental studies), which you will use for homework problems. Other applied examples come from the book and from lectures.

May X^{th} and Y^{th} are the make-up days for Spring 2 onsite classes. Do not make plans for those days.

Week	Content	Reading/Video/Audio for Today	Due
1	• Professor and Student Introductions • Lecture 1: Causality, Potential Outcomes and Counterfactuals • Group Exercise: Design an Experiment • Lecture 2: Why Experiment?	• Anderson & Simester. 2011. A Step-by-Step Guide to Smart Business Experiments. *Harvard Business Review* • Scheiber. 2017. *How Uber Uses Psychological Tricks to Push Its Drivers' Buttons* • You might want to start on Week 2 readings early	Bring to class a causal question in which you are interested – type it on a piece of paper (e.g., "I'm interested in knowing whether offering incentives for peer referrals increases sales." "I'm interested in determining if microloans to women can increase single, female-led household incomes and health.")
2	Lecture 3: Experimental Designs I Group Exercises	• Chapter 1 (1.1-1.4) in Gerber and Green • Chapter 2 **and** Chapter 3 in Gerber and Green [yes, it's a lot of reading]	Excluding chapter 1, type 3 questions you have about each chapter reading and a brief explanation of why you have this question (1-3 sentences for each of the 3 Qs)
3	Lecture 4: Experimental Designs II and Covariate Adjustment Guest Speaker	• Chapter 4 in Gerber and Green • Ferraro & Price (2013)	*Homework 1 due* For each chapter, type 3 questions you have about the readings and a brief explanation of why you have this question (1-3 sentences)
4	Lecture 5: One-way noncompliance Group Exercises Guest Speaker	• Chapter 5 in Gerber and Green • Optional reading on statistical power [Brock and Vasilaky, 2014, pp. 1-7]	*Homework 2 due* For each chapter, type 3 questions you have about the readings and a brief explanation of why you have this question (1-3 sentences)
5	Lecture 6: Two-way Non-Compliance Group Exercises Guest Speaker	• Chapter 6 in Gerber and Green • Thornton (2010)	*Homework 3 due* For each chapter, type 3 questions you have about the readings and a brief explanation of why you have this question (1-3 sentences)
6	Lecture 7: Threats to Validity Guest Speaker Group exercises	• Chapter 7 and Chapter 8 (through 8.3) in Gerber and Green • Blog posting on randomized saturation designs	*Homework 4 due* For each chapter, type 3 questions you have about the readings and a brief explanation of why you have this question (1-3 sentences)
7	Lecture 8: Heterogeneous Treatment Effects & Ethics of human experimentation Group exercises	• Chapter 9 and Appendix A in Gerber and Green	*Homework 5 due* For each chapter, type 3 questions you have about the readings and a brief explanation of why you have this question (1-3 sentences)
8	Student Presentations	No readings	Final projects are due

Carey Business School
Policies and General Information

Blackboard Site
A Blackboard course site is set up for this course. Each student is expected to check the site throughout the semester as Blackboard will be the primary venue for outside classroom communications between the instructors and the students. Students can access the course site at https://blackboard.jhu.edu. Support for Blackboard is available at 1-866-669-6138.

Course Evaluation
As a research and learning community, the Carey Business School is committed to continuous improvement. The faculty strongly encourages students to provide complete and honest feedback for this course. Please take this activity seriously; we depend on your feedback to help us improve. Information on how to complete the evaluation will be provided toward the end of the course.

Disability Support Services
All students with disabilities who require accommodations for this course should contact Disability Support Services at their earliest convenience to discuss their specific needs. If you have a documented disability, you must be registered with Disability Support Services (carey.disability@jhu.edu or 410-234-9243) to receive accommodations. For more information, please visit the Disability Support Services webpage.

Honor Code/Code of Conduct
The Carey community believes that honesty, integrity, and community responsibility are qualities inherent in an exemplary citizen. The objective of the Carey Business School Honor Code is to create an environment of trust among all members of the academic community while the qualities associated with success are developed in students. All students are expected to view the Carey Business School Honor Code/Code of Conduct tutorial and submit their pledge online. Please contact the Student Services office at carey.students@jhu.edu if you have any questions.

Students are not allowed to use any electronic devices during in-class tests. Calculators will be provided if the instructor requires them for test taking. Students must seek permission from the instructor to leave the classroom during an in-class test. Test scripts must not be removed from the classroom during the test.

Student Conduct Code
The fundamental purpose of the Johns Hopkins University's regulation of student conduct is to promote and to protect the health, safety, welfare, property, and rights of all members of the University community as well as to promote the orderly operation of the University and to safeguard its property and facilities. As members of the University community, students accept certain responsibilities which support the educational mission and create an environment in which all students are afforded the same opportunity to succeed academically. For the full policy, please visit the Student Conduct Code website.

Student Success Center
The Student Success Center offers free online and in-person one-on-one and group coaching in writing, presenting, and quantitative courses. The center also offers a variety of workshops, exam study sessions, and instructor-led primer seminars to help prepare students for challenging course content, including statistics and accounting. For more information or to book an appointment, please visit the Student Success Center website.

Other Important Academic Policies and Services
Students are strongly encouraged to consult the Carey Business School's Student Handbook and Academic Catalog and Student Resources for information regarding the following items:

- Statement of Diversity and Inclusion
- Inclement Weather Policy